BE 882,450

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KINGDOM OF BELGIUM
MINISTRY OF ECONOMIC AFFAIRS
PATENT NO. 882,450

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Invention Patent:

The Minister of Economic Affairs
In view of the law of May 24, 1854 on patents of invention;
In view of the affidavit addressed March 26, 1980 at 3:35 p.m. to the Patent Right Department;

Decrees:

Article 1. - That there be granted to the Company known as Ransburg GMBH, 6056 Hensenstamm, (Germany) (R.F.A.) represented by Bureau Gevers S.A., Brussels

A patent of invention for:

DEVICE FOR ELECTROSTATIC DISPERSION IN THE FORM OF A CONE OF A COATING SUBSTANCE

Article 2. - That this patent be granted to them without previous examination, at their risk and peril, without guarantee either as to the reality, the novelty, or the merit of the invention, or as to the exactitude of the description, and withut prejudice to the rights of third parties.

One of the copies of the specification of the invention (descriptive memorandum and any drawing) signed by the interested party and filed in support of his application will remain attached to the present decree.
Burssels, April 15, 1980
By Special Delegation:
The Director General
[signature]
L.Salpeteur

The invention relates to a device for electrostatic dispersion of a liquid coating substance in the form of a cone, for example, varnish, paint, rust-proofing coating or similar, which is supposed to be deposited on pieces, this device including a rotating atomization element, for example, in the form of a disk or a bell, of which at least the parts situated radially to the exterior are normally rotationally symmetrical with respect to its axis of rotation and which is under high voltage with respect to the pieces - or more precisely, of which the potential difference with respect to these pieces is great -, the substance to be projected flowing over this component in the form of a film in a radially or also radially and axially continuous manner towards the exterior, towards the projection edge. The electrostatic forces and/or the centrifugal forces project the coating substance at this edge, and then the electrostatic charge which it has absorbed directs it towards the pieces on which it is precipitated. The atomization element can be entirely made of electrically conductive material or may only be coated with conductive material so that the conduction and/or the electrical ionization creates in the coating substance a corresponding charge in the zone of the exterior edge of the atomization element, this edge constituting a dispersion edge in the electrostatic sense.

The side of the atomization element which forms the surface on which the liquid film moves in these apparatuses is preferably that which is situated in the direction of the flow. The side of the atomization element on which the liquid coating substance moves can however also in certain cases be that which is opposite to the direction of the flow. In this particular context, direction of flow is understood to mean the extension of the axis of rotation of the atomization element going way from the intake of the paint and the shaft of this component.

The paint can arrive in these devices through the support shaft of the atomization element. It can however also arrive through a stationary tube situated to the side of this shaft. When the liquid coating substance must be discharged on the side of the atomization element which is situated in the direction of the flow, the stationary tube can pass through a corresponding hole of the atomization element which, in this case, is generally in approximately the shape of a bell and which is then supported by a special corresponding star-shaped component mounted on the shaft and through whose holes the liquid can flow on the internal surface of the bell towards the projection edge.

The applicant sells devices of this type which are described, for example, in Belgian Patent No. 555,942.

In the known devices of this type, which generally function at speeds on the order of 1000 rpm, the coating substance which must be dispersed in the form of a cone flows towards the exterior edge, shaped in the form of a knife with a sharp edge, of the atomization element, then the electrostatic forces as well as the centrifugal force make it leave this atomization element along this edge, and it is transformed then into a highly charged mist. The diameter of the atomization element is, for example, in a range of 20 to

500 mm. The atomizers of this type are capable of distributing conventional varnishes or similar substances at flow rates which can reach approximately 3 cm^3 per minute and per cm of length of the projection edge of the atomization element.

A considerable rise in the rate of atomization allows one to considerably raise the dispersion capacity - this observation being valid for atomizers of any dimensions and quite particularly for relatively small atomizers, with a diameter of approximately 20 to 100 mm-. It is thus possible to raise to a multiple of the values reached up to now, the flow rate of the substance which is atomized and deposited on the pieces by operating the apparatus at speeds of 10,000, 20,000 rpm or even more of the atomization element. Experimentation shows however that in this case, the deposit of varnish on the piece is not always satisfactory. It can occur that the layer of varnish deposited by the electrostatic atomization element turning at such speeds can contain fine bubbles which lower the quality of the layer deposited to such a point that it is not acceptable in practice.

It is understood that the numerical values mentioned above and referring to the speeds, diameters and other values can vary as a function of different parameters such as the composition of the varnish, the temperature of spraying, the humidity of the air, the shape of the atomization element and other parameters, with the fundamental problem however remaining the same.

The invention relates to a atomizer of the type specified above, but which, in spite of its very high speed of rotation on the order of 20,000 rpm or even more, makes it possible to deposit impeccably on the piece, in particular without the aforementioned formation of small bubbles, the varnish which is dispersed at a high flow rate corresponding to this speed.

The invention therefore relates to an atomizing device in the form of a cone a liquid coating substance to be deposited on pieces, by means of a rotating atomization element which is under high voltage with respect to these pieces and on which the substance to be dispersed flows continuously in the form of a film radially or radially and axially outward towards the projection edge; according to an essential particularity of the invention, the surface of the atomization element on which the film of substance moves is recessed towards the interior from the exterior edge along the part near this edge. According to a very advantageous embodiment of the invention, the surface on which the film of substance moves - which is normally and preferably the surface of the atomization element which is situated in the direction of flow - and which reaches an annular surface, situated in a plane perpendicular to the axis of rotation of the atomization element and whose radial length can be deduced to zero at the limit turns back towards the rear, to the rear of this perpendicular plane, then reaching, only a short distance from there, the exterior edge, situated radially further outwards, of the atomization element which forms an edge - preferably a sharp edge such as that of a slightly blunt knife.

Although this exterior edge is preferably circular, it is not necessarily circular. Other similar forms are possible provided that they do not excessively take away from atomization element its symmetrical form generated by revolution. The turning back of the surface which is near the exterior edge of the atomization element and on which the film of substance moves can consist, for example, of an extension of this surface which is made up of a conical exterior surface element. Conical exterior surface element should be understood in this case to mean a surface element in which the

body which contains this conical surface is inside the envelope of the cone and not outside of it. The conical exterior surface does not necessarily have to be a surface with a straight generating line. Conical exterior surface should also in this sense be understood to mean a surface generated by revolution created, for example, by revolution of a curved element. It is however essential in this case for one of the ends of the conical exterior surface - or more precisely of the truncated conical exterior surface - to be situated radially further outwards than the other. In the particular case, the end of said generating line which is connected to the exterior edge must naturally be that which is most to the exterior.

The surface on which the film of substance moves can also be, for example, recessed towards the exterior edge in such a way that the atomization element has, at this place, a profile similar to that of the circumference of a railway wheel.

Tests performed with a disk-shaped atomization element on which the coating substance is discharged on the side situated in the direction of the flow and whose edge is tapered at an angle of 45° towards the other side, in such a way that the edge, which inscribes an angle of 45°, is formed between the mathematical conical surface generated by grinding and the other flat side, have shown that the liquid becomes detached at least partially in the zone of the conical surface of the atomization element, therefore before reaching the electrostatic dispersion edge formed by the sharp exterior edge. According to an embodiment of the invention and based on this observation, the electrostatic projection edge (therefore the sharp edge on which the concentration of the lines of the electrostatic field is the highest) of the atomization element is a radial distance outward from the zone of projection by

centrifugation (that is to say the zone in which at least the major part of the liquid leaves the atomization element) and preferably to the exterior of the foreseen path of travel which the mist is supposed to follow. The electrostatic dispersion edge is in this case advantageously also axially separated from the zone of projection by centrifugation preferably on the opposite side to the direction of flow of the device. A suitable mode of construction can make it possible to reduce this axial distance considerably. In this case, it is however necessary for the radial distance to be sufficiently large.

The surface on which the substance moves preferably forms an extension with an obtuse angle consisting of a conical exterior surface forming the exterior edge. This obtuse angle is preferably between 120 and 150°. An angle of 130° has given good results. The conical exterior surface and the surface of the atomization element situated opposite the surface on which the substance moves advantageously intersect of the exterior radial edge of this component at an angle which can certainly be obtuse, but which is preferably a right angle or an acute angle.

The transition from the surface on which the substance moves to the conical exterior surface can be rounded. The radius of this rounded part is preferably small, for example, 1 mm. Good results have been obtained with a transition with a sharp angle from the surface on which the substance moves to the conical exterior surface. As for the rounded transition, it has the advantage that the concentration of the lines of field is less diminished on the radially exterior edge of the atomization element.

The angle of inclination of the generating lines of the conical exterior surface with respect to the axis of rotation of the atomization element is advantageously approximately 30 to 60°.

It is preferably between 40 and 50°. An angle of 45° has given good results. When this generating line is not a straight line, this indication of dimension relates to the average inclination of the generating lines.

The length of the generating lines of the conical exterior surface or preferably the distance from the radially exterior edge to the transition from the surface on which the substance moves to the conical exterior surface is determined according to the particular case. Lengths of 2 to 8 mm have given good results for atomization element diameters between 2 and 10 cm, this length not necessarily increasing with the diameter of this component, but rather being a function of each particular case.

The surface on which the substance moves is advantageously perpendicular to the axis of rotation upstream from its transition to the recessed zone. The annular zone, perpendicular to the axis of rotation, of the atomization element can be extended radially up to the zone of its shaft, in particular when it is in the form of a disk. In another apparatus (such as that which is represented in Figure 1 of the appended drawings) whose surface swept by the substance is situated in the direction of the flow and which forms a slight projection in this direction with the increase of the radius, a radial length of 2 mm of the zone perpendicular to the axis of rotation has given excellent results in the past.

The generating line of the conical exterior surface can be a straight line, as mentioned above. But it can also be a curve whose curvature is such that this surface forms a turn in in its middle; it is also possible to give a convex form to the conical exterior surface.

The invention will be described in more detail in reference to the drawings attached as non-limiting examples and in which:

Figure 1 essentially represents a atomization element according to the invention in axial section and on a scale of 2:1;

Figure 2 illustrates a variant embodiment of an apparatus according to the invention, the atomization element being also represented in axial section; and

Figures 3 to 12 illustrate in partial axial section other variant embodiments of the atomization element according to the invention.

The support, the control device, and the elements for introduction of high voltage to atomization element 1 of Figure 1 are not represented in this figure, because they are well known. Atomization element 1 of this embodiment is supported by shaft 2 which has carrier disk 3 at the end. This disk 3 has multiple passages 5 at the circumference which is concentric to axis 4 of rotation of shaft 2. Bell-shaped atomization element 1 is attached to the circumference of carrier disk 3, in a well known manner which is not represented, so that a part of its internal volume is on the side of the shaft of disk 3 and the major part of this volume is on the opposite side from this shaft, on the side of disk 3 which is turned in the direction of projection. Atomization element 1, shaft 2, and disk 3 are made of steel. They can also be made, for example, of a plastic material which is a nonconductor of electricity and which is covered with a semiconductive metallic coating so that the high voltage applied by the apparatus to shaft 2 and to disk 3 can be distributed over the atomization element and for a field around it.

The coating liquid which is to be projected is directed over the atomization element 1 through tube 6 which comes from the apparatus and which is oriented radially towards the exterior over a short distance, to the rear of internal collar 7 of the bell, in

order to open near the internal surface of bell-shaped component 1. A drive means not represented can make shaft 2 turn, for example, at 25,000 rpm.

The coating substance which is intended to be sprayed can be a varnish capable of being projected at a high flow rate, for example, an alkylmelamine resin. Arrow A indicates in Figure 1 the most frequent direction of projection.

The exterior surface of bell-shaped atomization element 1, with the exception of its part which is going to be described and which is around the radial exterior edge situated to the right in Figure 1.

Atomization element 1 has, on the side situated in the direction of spraying A, surface 8 of which the parts closest to axis of rotation 4 are at least approximately in a plane perpendicular to this axis of rotation, but which curves slightly in the direction of projection with increasing radius and finally extends along edge 9 in the form of an annular surface which is exactly in a plane perpendicular to axis of rotation 4 and which has a radial width of 2 mm. Exterior edge 11 of this annular surface 10 forms a sharp angle transition to conical surface 12. The angle which the generating lines of this conical surface 12 inscribe with the axis of rotation is in this particular case 45°. The side of this conical surface in the direction of the length of its generating lines is 2 mm. Conical surface 12 forms, on its radially exterior edge, a sharp angle 13 with exterior surface 14, which is also conical in this zone, of bell-shaped atomization element 1. The two conical surfaces 12 and 14, whose points are naturally turned opposite to one another, intersect along edge 13 at an angle of 90° measured in a plane passing through the axis.

The dimensions borne by Figure 1 as well as the structure of atomization element 1 represented in this figure have given good results in practice. This atomization element allows one to raise the flow rate of varnish per centimeter of length of its circumference in a surprising manner to a multiple of that of components from prior art for a corresponding speed of rotation, for example, 15,000 or 30,000 rpm, and to disperse this varnish in the form of a cone which allows one to obtain a good quality deposit with no defects as mentioned above.

The varnish is directed in operation through pipe 6 into the rear part of the cavity of bell-shaped atomization element 1. The centrifugal force makes the varnish progress from there through passages 5 in the direction of flow, this varnish being distributed then in the form of a film on surface 8 from which it progresses radially towards the exterior onto surface 10 and is then projected. The electrostatic field then directs the mist of varnish, which takes the form of a symmetrical bell generated by revolution whose thickness increases greatly towards the edge of this bell, from the atomization element towards the piece which is normally grounded.

Apparatus 20 represented in Figure 2 receives the high voltage of cable 21 and the coating substance to be sprayed, for example, a very good quality varnish, from pipe 22. The drive motor which is in housing 23 of the apparatus receives the energy necessary for its functioning through a line which is not represented. Shaft 24 which turns at high speed, for example 20,000 rpm, and which is in one piece, at the right end in the representation of Figure 2, with discoid atomization element 25, comes out to the right of housing 23, in the manner represented in Figure 2. Shaft 24 is hollow and the varnish is directed through it axial bore towards surface 26 of

atomization element 25, which is situated on the side of the direction of flow as indicated by arrow A.

Atomization element 25, which has a diameter of 55 mm and which receives the high voltage of line 21 and hollow shaft 24, is ground in a cone shape along its exterior edge in the manner represented in the drawing, so that the circumferential surface of this body 25, which is furthermore delimited (insofar as this form is functionally significant) by two planes perpendicular to axis of rotation 27, consists of a conical surface 28 whose straight generating line inscribes an angle of 45° with the axis of the cone which coincides with axis of rotation 27, the point of the cone being on the side corresponding to the direction of flow.

When shaft 24 turns at a suitably high speed and the varnish arrives through the hollow shaft, this varnish arrives in the form of a film as indicated by the curved arrow 29 on the front surface 26 of component 25 situated on the side of the direction of flow and is directed radially towards the exterior and is finally detached from atomization element 25 in the zone of edge 30 and conical surface 28.

Atomization element 35 represented in Figure 3, like the components of Figures 4-9 as well as 11 and 12, causes the film of varnish to run over its surface turned towards the right in these figures and which is situated on the side of the direction of flow. This surface comes back towards the rear, to the rear of annular edge 36 and towards sharp exterior circumferential edge 37, forming a conical envelope.

The atomization elements of Figures 3-12 can be made of metal, but they can also be made, for example, of plastic material and have a conductive or semiconductive surface formed, for example, by a thin metallic coating.

Atomization element 4 represented in Figure 4 does not differ essentially from component 25 of Figure 2 except by a curved conical surface 43 whose transition to surface 41 is gradual and which is between surface 41 turned on the side of the projection and situated in a plane perpendicular to the axis of rotation and the exterior circumferential edge 42.

Atomization element 45 represented in Figure 5 does not differ essentially from component 35 of Figure 3 except that edge 36, which is sharp in atomization element 35, is replaced in this particular case by a rounded transition.

Figure 6 illustrates atomization element 50 whose surface 51 on which the coating substance moves goes back slightly towards the rear with increase of the radius in order to show that this surface of a component according to the invention and on which the coating substance moves does not necessarily have to be perpendicular to the axis of rotation or form a great projection in the direction of projection [of the substance] with increase of the radius. The size of this recess must, however, be sufficiently small so that the liquid is not released prematurely. The angle of conicity α of this surface must therefore if possible be only a few degrees, for example 3°.

Component 50 corresponds moreover to atomization element 25.

Atomization element 55 of Figure 7 essentially represents a combination of components 35 and 50. The part near the center of element 55 is shaped like that of element 35. The hollow conical surface 56 on which the liquid moves and which is turned in the direction of flow extends at 57 along a bend in the form of conical exterior surface 58 whose angle of conicity α is also very low. The axial dimension of conical surface 58 is also low. This surface extends to the rear of annular edge 59 by conical surface 60 which

is much more inclined and finally ending with exterior circumferential edge 61. In this embodiment, the projected film is already released from the atomization element in the zone of edge 59, as in atomization element 50 of Figure 6 whose liquid is released in the form of a mist already in the zone of edge 52.

Atomization element 65 of Figure 8 ends along its radially exterior edge with tapered edge in the form of annular blade 66. The slightly conical and hollow surface 67 of this atomization element on which the liquid moves is extended beyond curved edge 68 by conical surface 69 which is slightly curved towards the inside in the form of a spout which finally ends with annular edge 66.

Atomization element 70 represented in Figure 9 also has relatively sharp exterior circumferential edge 71 between convex rear conical surface 72 and front conical surface 73 which is curved towards the interior, that is to say which is concave and which forms the transition between concave hollow conical surface 74 and the circumferential edge.

Figure 10 illustrates atomization element 80 on which the coating substance is not directed on the surface situated on the side of the direction of flow, but on surface 81 turned towards the side opposite to that of the direction of flow. The liquid varnish is sent for this purpose into the annular space between two tubes 82 and 83 concentrically surrounding shaft 84 and opening a short distance to the rear of rear surface 81 which forms a slight swelling in this zone. In this embodiment also, surface 81 on which the liquid film moves is also connected to exterior edge 86 by conical surface 85. However, contrary to atomization element 25, the exterior edge is in this case in the plane of surface 87 of component 80 which is more to the front in the direction of flow.

Atomization element 88 illustrated in Figure 11 has basic structure similar to that of atomization element 1. The coating substance in this case arrives through a stationary tube which is not represented. This substance then flows radially towards the exterior along hollow conical surface 89, as indicated by the arrow, and is then directed more towards the exterior over annular surface 90 which has a small radial dimension and is situated in a plane perpendicular to the axis of rotation. The greater part at least of the liquid becomes detached forming a mist in the zone of rounded rim 91. The surface of the atomization element turns back from rounded rim 91 towards the rear, in the direction opposite to that of the flow, in order to form roughly cylindrical surface 93, it is then directed again radially towards the exterior and reaches edge 92 in the form of a knife blade on which the highest concentration of field lines predominates.

Figure 12 illustrates atomization element 95 whose principle is similar to component 88. In this case, the liquid still arrives through the hollow shaft, as represented in the drawing. This liquid then flows radially towards the exterior along hollow conical surface 96 and is sprayed in the zone of rounded rims 97. The surface turns back to the rear of rim 97 clearly towards the rear, in the opposite direction from that of the flow, and is finally extended by spout 98 whose radially outward edge 99 also forms the circumferential edge of atomization element 95. in this case also, this edge is tapered. The general direction of this edge is oriented obliquely towards the exterior, in the direction of flow, in the plane of the drawing of Figure 12. The distance parallel to the axis between edge 99 and rounded rim 97 of this embodiment can be very small.

Claims

1. A device for projection in the form of a cone of a liquid coating substance which is supposed to be deposited on a piece, said device including a rotating atomization element which is under high voltage with respect to the pieces and on which the substance to be projected flows continuously in the form of a film radially or radially and axially towards the exterior and towards the projection edge, characterized by the fact that surface (8, 10, 26) of atomization element (1, 25) on which the material film moves is recessed near exterior edge (13) of this component.

2. A device for electrostatic dispersion in the form of a cone of a liquid coating substance which is supposed to be deposited on pieces, said device including a rotating atomization element which is under high voltage with respect to the pieces and on which the substance to be projected flows continuously in the form of a film radially or radially and axially towards the exterior and towards the projection edge, in particular according to Claim 1, characterized by the fact that electrostatic projection edge (13) of atomization element (1) is a radial distance to the exterior of the zone of projection by centrifugation (11, 12) and is preferably to the exterior of the foreseen path of travel of the mist.

3. A device according to Claim 2, characterized by the fact that electrostatic projection edge (13) is an axial distance away from zone (11, 12) of projection by centrifugation - preferably in the direction opposite to that of the flow in the device.

4. A device according to any one of Claims 1 to 3, characterized by the fact that surface (8, 10) on which the substance flows extends under an obtuse angle in the form of conical exterior surface (12) forming exterior edge (13).

6. A device according to Claim 4, characterized by the fact that sharp edge (11) forms the transition between surface (8, 10) on which the substance moves and conical exterior surface (12).

6. A device according to Claim 4, characterized by the fact that the transition from the surface on which the substance moves to the conical exterior surface is rounded (46, 68).

7. A device according to any one of Claims 4 to 6, characterized by the fact that the (average) angle of inclination of the generating lines of conical exterior surface (12) inscribes an angle of approximately 30 to 60°, preferably 40 to 50° with the axis of rotation of the atomization element.

8. A device according to any one of Claims 1 to 7, characterized by the fact that the surface on which the substance moves is perpendicular (10) to axis of rotation (4) in front of its transition to the recessed zone.

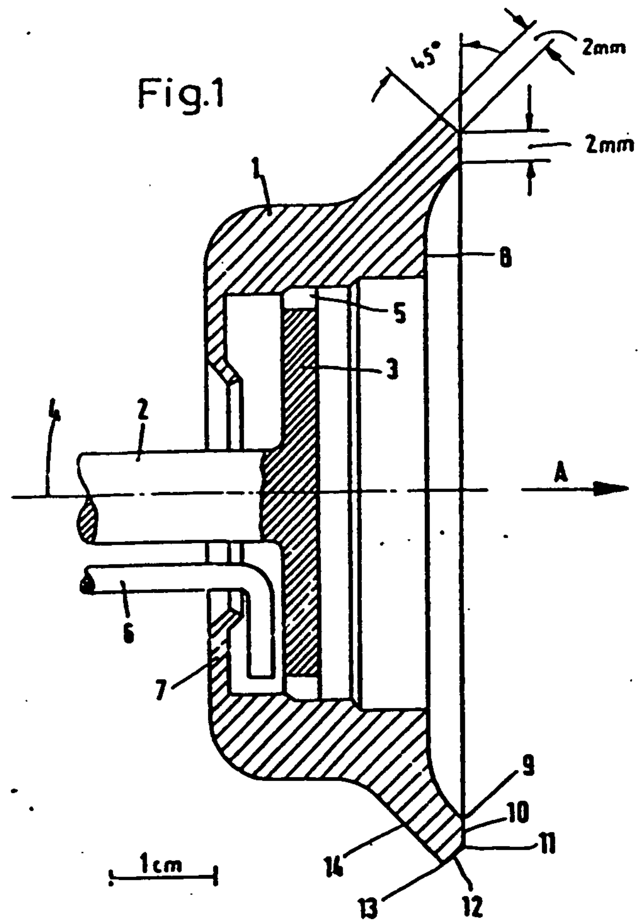
9. A device according to any one of Claims 4 to 8, characterized by the fact that the conical exterior surface forms a hollow in the middle (Figures 8, 9, 11, 12).

10. A device according to any one of Claims 1 to 9, characterized by the fact that atomization element (25) has the form of a flat disk rotating around its axis (27), of which both sides are flat and have a tapered edge, oriented on one side in the opposite direction from that of the flow forming a cone (28) whose angle of conicity is 45°, surface (26) turned on the side of the direction of flow being that on which the substance moves (Figure 2).

11. A device according to any one of Claims 1 to 9, characterized by the fact that the generating line of the surface generated by revolution (8, 10, 12) on which the substance moves and which is turned in the direction of the flow is oriented first

of all a distance radially outward from axis of rotation (4) and perpendicularly (8) to this axis, then it curves slightly towards the front in the direction of flow until it inscribes an angle of approximately 30° with the perpendicular to the axis of rotation, then it forms edge (9) of transition from part (10) which is perpendicular to the axis of rotation and finally forms the transition along edge (11) of part (12) inclined towards the rear at an angle of 45° and ending with exterior circumferential edge (13) of the atomization element, this edge inscribing an angle of 90° (Figure 1).

Fig.1



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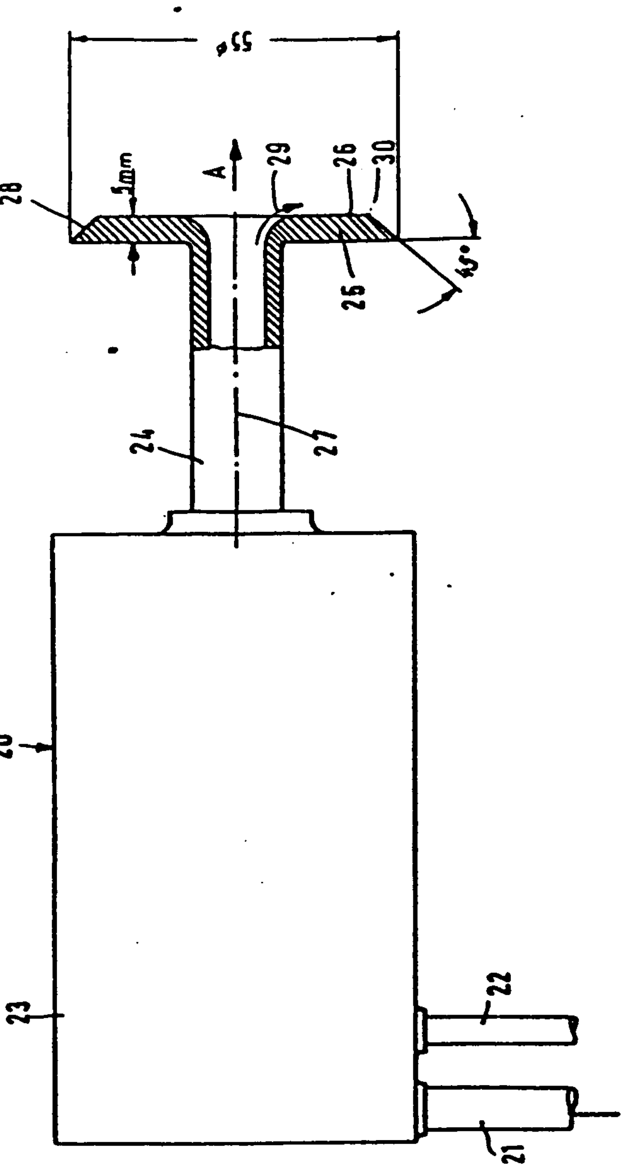

Fig.2

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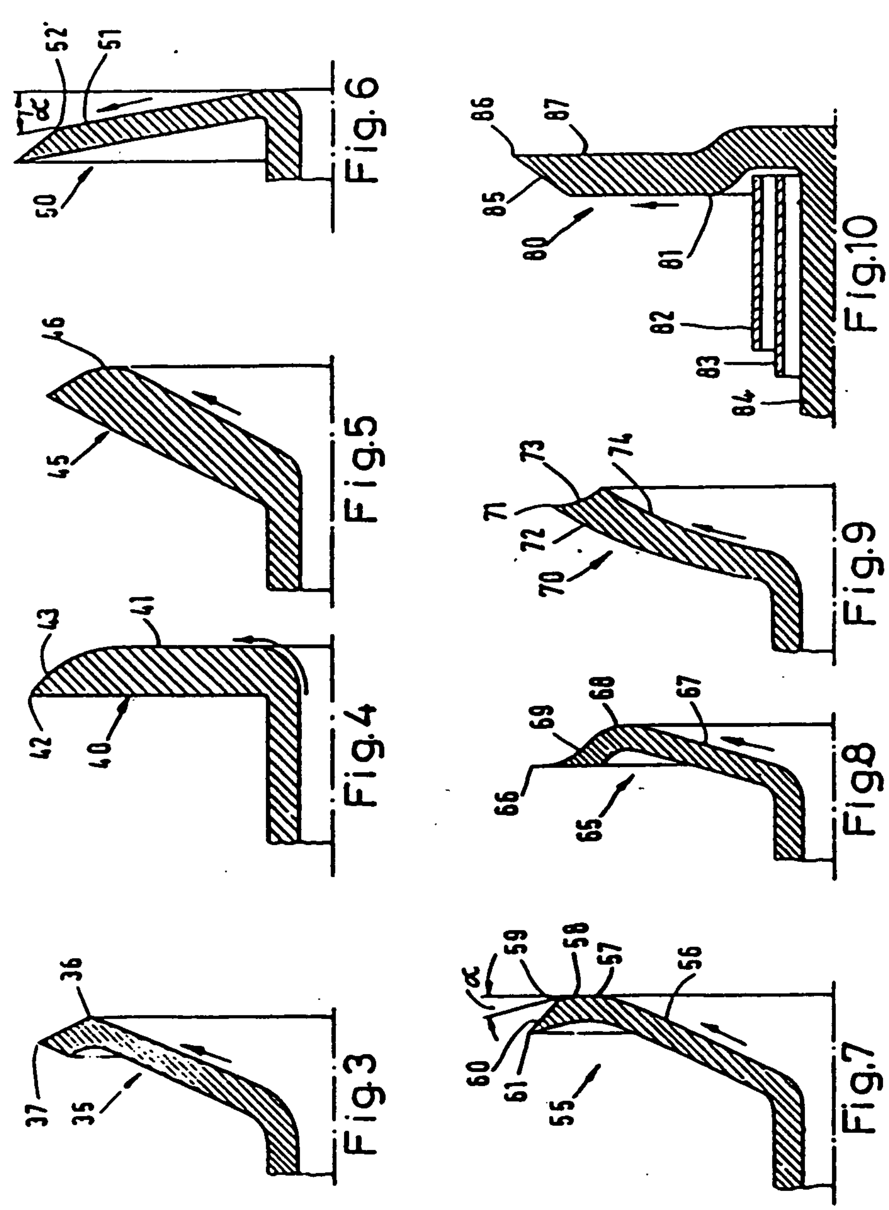

Fig.3 Fig.4 Fig.5 Fig.6 Fig.7 Fig8 Fig.9 Fig.10

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Fig. 11

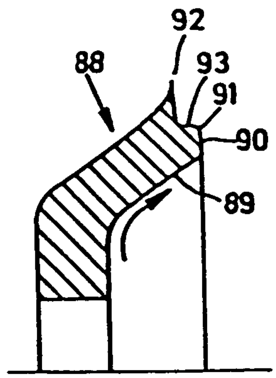
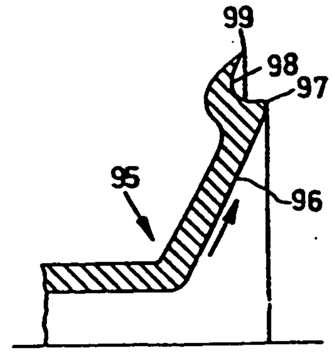


Fig. 12



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